Printed for Departmental use.

GLYCERINATED CALF-VACCINE LYMPH.

REPORT

TO THE

G. B., LOCAL GOVERNMENT BOARD

ON THE

STATE ANIMAL VACCINE ESTABLISHMENTS OF GERMANY,

BY

DR. R. BRUCE LOW.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By DARLING & SON, Ltd., 34-40, Bacon Street, E.

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Dr. Bruce Low's Report to the Local Government Board on the State Animal Vaccine Establishments of Germany.

THE Board having become desirous of obtaining at first hand, through their administrative staff, details respecting State vaccine establishments in Germany, and information also as to the quality of the vaccination resulting from use of lymph prepared by these establishments, I was instructed to visit some of these lymph institutes and to report generally upon them. My inquiries were made during May and June of the present year.

There are in Germany 21 State Animal Vaccine establishments wholly maintained out of public funds, each of which serves for a state, province, or group of smaller states. In addition there is a similar establishment, set up many years ago by private enterprise, which contracts with six of the smaller German States to supply, at a fixed price per "portion," all lymph needed for public vaccination in these territories. Furthermore, there exist several private lymph institutes, run on a commercial basis, which produce lymph for the supply of private medical men or for export abroad. These private establishments are under state inspection.

Of these various German vaccine establishments* I was able, in the time at my disposal, to visit 14, in which number were comprised fairly representative examples both of the larger and the smaller institutes. My thanks are due to the various medical directors of these lymph establishments for their courtesy to me during my inquiry, and for the trouble they took to furnish me with information.

It may be stated generally that these vaccine establishments in Germany are, in the majority of instances, of simple and economical character, and that they meet all current requirements of the populations for which they serve. In the matter of cost of construction the recently erected vaccine institute at Munich is an exception, everything having been provided there of the best and newest description at considerable expense (*see*

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* In the official report of the Central Imperial Health Office at Berlin the State Vaccine Establishments are given as 22, the private establishment, alluded to above, being classed for statistical purposes as a State Vaccine Establishment.

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page 23). In nearly all cases the vaccine institutes have been erected near, often within, the grounds of the public abattoir, or central cattle market, an arrangement which is very convenient, especially in the smaller towns, since it facilitates the obtaining, the feeding, and tending of the calves, as also the veterinary inspection of these animals during life and after they have been slaughtered by the officials of the public abattoir; in this way reducing the wages bill of the vaccine establishments. Generally these institutes consist of five apartments, with outbuildings, viz., (1) a stable, with stalls for the calves used for the production of lymph; (2) a second stable, entered by a separate door, in which calves may be isolated; (3) an apartment in which the calves are vaccinated and where the lymph is afterwards collected from them; (4) a laboratory where the pulp is triturated and emulsified; (5) an office where the records are kept and where the lymph is stored in an ice chest, and where the clerk or assistant fills the tubes and packs and despatches the lymph. In some instances this "office" is a room at the residence of the medical director, where sometimes also the lymph is prepared and emulsified. The staff usually employed comprises (1) the medical director, who is also a public vaccinator and in most instances holds other important official appointments, *e.g.*, medical adviser to the State or Principality in which the institute is situated, or medical officer of health for the town in which he resides. His salary as director is generally of modest dimensions, ranging from £25 to £200. (2) A medical assistant, who is, in most instances, a young general practitioner in the town, with a salary ranging from £15 to £60 per annum. (3) A veterinary surgeon, generally a part time officer, often attached, as has been said, to the public abattoir, and receiving sometimes merely a retaining fee of £5 5*s*., or it may be a fixed salary from £20 to £60 per annum. In one instance a fee of 4 marks is paid for each animal inspected. (4) A clerk who keeps the records, and who packs and despatches the lymph. Very frequently this post is filled by a lady, who in some cases gives whole time to the duties and assists in filling the tubes with lymph, and even at times lends a hand in the laboratory. The salary of the clerk varies from £15 to £50 per annum. In at least one instance rooms are provided for the lady clerk in addition to her salary. (5) An attendant who feeds and waits upon the animals. He is frequently an employé in the public abattoir, giving only part time to the lymph institution; but in the larger establishments he gives whole time and resides upon the premises. He receives the ordinary wages of men of his class.

The animals used in the production of lymph are generally young calves from a few weeks to a few months old, but in several institutes, especially in those of Southern Germany, young uncastrated bulls, aged from six months to two years, are made use of. There is a difference of opinion, I understand, as to whether the use of the smaller or the larger animals is the

better and more economical. In a few establishments animals of both kinds are being used, and observations are being made with a view of deciding this point. It is perceived that the larger animals are more liable to be affected by tubercle, and that the more lymph is likely to be lost if the large animal on being slaughtered shows signs of this disease. (It is almost unnecessary to say that in Germany, as elsewhere, no lymph is stored till a veterinary surgeon has examined the animal immediately after it has been killed, to ascertain if it has any trace of tubercle or other disease.) Another objection that has been urged against the employment of the larger animals is that from their size and strength they struggle more violently, and accidents are therefore more liable to occur. On the other hand when the larger animals are used for lymph production the amount of pulp available is greatly increased and hence far fewer animals are required, and this means considerable reduction in expenditure of money and also of labour. When bulls are vaccinated, it is held that the lymph collected from the surface of the scrotum is of greater activity than other lymph, and that therefore this practice increases the value of the lymph.

It is the custom in some establishments to mix together the lymph of several animals that have been vaccinated on one and the same day. It is considered that in this way a more uniformly active lymph is obtained; that the more active lymph yielded by some animals compensates for the less active lymph yielded by others of the group, experience being to the effect that certain animals, for unknown reasons, give lymph of feeble activity, so that it is not possible at the time of vaccinating to foretell the kind of lymph that will be afforded by a given animal.

In most localities in Germany there is at present no special difficulty in obtaining the number of calves or of the larger animals required for lymph production, though perhaps at times of prevalence of epizootic disease it may prove otherwise. The animals are usually obtained through a contractor, and the proximity of the lymph establishment to the public market facilitates, as has been said, the operations of the contractor. In most instances the bovine animal is only loaned for the purpose of lymph production, the fee paid varying according to the size and age of the animal, and differing also perhaps according to the locality; establishments situated in the neighbourhood of grazing districts getting animals comparatively cheaply, while lymph institutes situated in large cities or in industrial districts are called upon to pay more. Thus the amount paid for the hire of young calves varies from 7 to 20 marks, and for the larger animals from 35 to 80 marks (a mark may be taken as equal to one shilling of English money). The price actually paid at each vaccine establishment visited will duly appear.

The amount paid for loan of lymph producing animals shows a tendency to increase year by year. This may be due partly to the increase in the price of flesh-meat in Germany that has been going on of late, along with the general advance in the cost of living in towns and populous districts.

A general preference is shown for calves or bulls of a light colour; their skins being said to be finer in quality and to yield better results than the coarser skins of darker animals.

The usual area vaccinated in the calf extends from the anterior edge of the buttocks to the umbilicus; but in Hamburg the calf's belly is not vaccinated, only the perinaeum and the right side of the animal to its shoulder. The skin in all cases is carefully shaven over the area to be vaccinated before the operation is performed, and some careful washing of the surface with soap and antiseptics is practised. In some establishments the animal receives a bath before it is vaccinated. The prepared surface is then scarified usually by a blunt instrument, in long parallel lines about 1 to 2 centimetres apart, and the lymph is rubbed in with the fingers or a spatula. The amount of lymph used to vaccinate a calf is from $1\frac{1}{2}$ to 3 grammes, and for a bull from 3 to 5 grammes. At some institutes the vaccinated surface is protected by the application of "Tegmin," a patent preparation made in Vienna, consisting apparently of white wax, glycerine, oxide of zinc and some other ingredients. It is spread on the abdomen with a spatula, and then a layer of sterilised cotton wool is applied over the surface. Several establishments formerly using Tegmin have discontinued its use on the ground that the vaccinated places did as well when no Tegmin was applied as when it was made use of. When this application is employed, it is usual to repeat the dressing two or three times during the interval between the vaccination and collection of the pulp.

The time at which the pulp is collected varies at different establishments from 72 to 120 hours. It is observed that in hot weather the vesicles ripen more quickly.

The average amount of pulp obtained per animal varies greatly. In one exceptional instance, which came under my own notice, a two-year old bull yielded as much as 82 grammes of active pulp. Commonly the amount of pulp collected from calves ranges from 6 to 17 grammes, that from bulls from 15 to 40 grammes.

At Cologne, and I believe at Oppeln, the calves are slaughtered a few minutes before the pulp is collected, and at Dresden, too, this course is sometimes followed.

Immediately after collection the pulp is triturated with glycerine and water in proportions generally of from equal parts to 4 of glycerine and 1 of water; the resulting emulsion finally containing 1 part of pulp to 3 or 4 of the glycerine and water mixture. Very active lymph is further diluted, in some cases up to 1 in 9.

In the majority of the German vaccine lymph establishments it is not now regarded as necessary to make repeated plate cultures from the lymph before its distribution, though in a few places this is still done. It is held that experience has shown that it is not necessary to test in each single instance for the presence of extraneous micro-organisms. The storing of glycerinated lymph for four weeks is found practically to free it from the presence of these organisms.

Commonly, after the pulp has been emulsified, it is put at once into tubes holding 100, or sometimes 50, portions,* and such tubes are stored in an ice chest for four weeks. The activity of the lymph is then tested sometimes on children's arms at the public stations, sometimes on rabbit's ears, or in both ways. The conjunction of the posts of director of the lymph establishment and public vaccinator is of considerable advantage in several directions, more especially as affording facilities for testing a lymph on children before sending out the bulk of it to the public vaccinators of the State or Province.

For calf vaccination purposes at some German vaccine institutes rabbits are employed, the lymph collected from four rabbits usually furnishing enough pulp to vaccinate a calf. Lymph for like purpose is also frequently taken from the arms of children at the public stations, a small gratuity being presented to the mother in each instance out of the public funds. Human lymph thus obtained is mixed with glycerine and water, four children affording enough material for the vaccination of a calf. Frequent exchange of lymph between the different vaccine establishments takes place, for the purpose of maintaining a satisfactory activity generally of lymph.

It is considered that the subdivision of lymph supply for the whole of Germany, among 22 government establishments, affords better opportunities for keeping up a continuous supply of active lymph than if the business of lymph production were concentrated in one large establishment. Thus, if from unforeseen circumstances, the yield of lymph from a particular institute fails temporarily, a supply can at once be obtained from one or more of the other establishments to meet the urgent demands of the State or Province in question.

The medical directors of these German State vaccine establishments have formed themselves into an association† which meets for a few days once in two years at selected towns. In this way opportunity is afforded for the discussion of points

* A "portion" is a charge sufficient to vaccinate an individual in at least four places.

† Versammlung der Vorstände der deutschen staatlichen Impfstoffgewinnungsanstalten.

arising in the course of their work of lymph production, and for comparisons of experience.

As regards the cost of producing vaccine lymph in Germany, it would appear that sufficient emulsified lymph (a so-called "portion") for the vaccination or revaccination of one individual can be obtained at a cost varying in different places from about a half-penny to a little more than a penny. In the annexed reports upon the various institutes visited, I have recorded in each instance the average number of portions or charges of lymph obtained per animal. It is obvious that the larger the number of portions obtained per animal, the smaller the cost of production. The largest average number of portions per animal obtained during 1904 was at Darmstadt, viz., 14,333, where bulls are made use of; the smallest average, 1,423 per animal, was at Cannstatt, where also large animals are employed. Taking the whole of the 22 establishments together, the average number of "portions" per animal in 1904 was 3,814. In this connection it is interesting to note that in the two Austrian vaccine establishments (at Vienna and Neuhaus, Bohemia), according to latest reports available, the average number of portions per animal was, for a series of years in both instances, over 7,000. In both of these Austrian institutes bulls are the animals used. (*See* Appendix A.)

At our own army vaccine institute at Aldershot, I am informed that the average number of portions, or charges, of lymph per animal for the last five years, is 4,128 (*see* Appendix B); and from a recent report on the Copenhagen Lymph Institute, it appears that the average number of portions obtained there per animal was 4,619.

It has to be borne in mind that the German method of vaccinating at public stations tends to economy in the use of lymph; and that in Germany there is not practised that subdivision of lymph into single portions in capillary tubes adopted in this country, where also the filling and despatch of these tubes adds to the labour and expense of distribution. The lymph keeps active longer in bulk (*e.g.*, 100 portions) than in single portions, and there is moreover less waste of the lymph. It has also to be kept in mind that the demands in a given year upon the resources of a German lymph establishment can almost always be forecast within almost definite limits, there being little fluctuation in the amount required year by year. In Germany too there is not need for maintaining large reserve stocks of lymph to meet sudden emergencies arising from smallpox outbreaks, as has to be done in our own country.

With a view to observing the results obtained from the use of German animal lymph I attended, along with the public vaccinators of various towns, at a number of public stations where infants were being vaccinated or inspected, and at others where school

children were being re-vaccinated or inspected. The results which I saw convinced me that the vesicles and scars were quite as good as are at present obtained in this country; moreover they were in no way inferior in my opinion to those produced in former years by human lymph in England and Wales. In order to obtain further information on this point I visited some schools, along with the medical officer of health of one large town (Cologne), and examined the primary marks on the arms of the children Many had six well defined foveated scars, and none that I saw had less than four scars, the combined area of scars in each case being quite up to the Local Government Board's standard.

I also questioned the older public vaccinators whom I saw, the majority of whom had had previous experience of the use of human lymph. Their testimony was unanimously to the effect that they saw no difference in the vesicles obtained from human as compared with animal lymph. Moreover, in their opinion, the scars resulting from the use of calf lymph are as well defined and as permanent as those following the use of human lymph. Occasionally, indeed, it happens that the lymph obtained from a calf is, for some undefinable reason, less potent than usual, and that the scars resulting from its employment are less lasting than, and not so well defined as, is requisite. But like results were formerly noticed in infants vaccinated from a child whose lymph was of feeble activity.

To sum up: It may be said that the methods of producing animal lymph in Germany appear to be satisfactory, and that they are carried out at comparatively small cost to the public funds. But it requires to be noted that success in the above sense is closely bound up with German Vaccination Law and the system of practically universal stational vaccination. The latter strongly tends to economy of lymph, while the former allows an estimate to be made each year of the probable amount of lymph that will be required in each province or state, so that over production or waste of lymph can be avoided.

In the statistical statements which I have annexed to the following brief account of each institute visited, I have availed myself of the figures for previous years given in the annual reports* issued by the Central Imperial Health Office at Berlin, and published in the "*Medizinal-statistische Mitteilungen aus dem Kaiserlichen Gesundheitsamte.*"

In Table I. is given a list of the 22 German vaccine establishments, the provinces or states for which they serve, and the population in each instance; the number of vaccinations actually performed with the lymph from each establishment in 1904; and the total number of portions produced in that year. Also the name in each instance of the medical director.

* Die Tätigkeit der im Deutschen Reiche errichteten staatlichen Anstalten zur Gewinnung von Tierlymphe.

TABLE I. showing the Towns in which the STATE VACCINE LYMPH ESTABLISHMENTS are situated, the areas they serve, the populations supplied with Lymph, the total vaccinations and re-vaccinations performed in 1904, and the number of "portions" of Lymph produced at each Institute. Also the name in each instance of the Medical Director.

—	Town in which the Lymph Institute is situated.	State or Province served by the Institute.	Approximate population served by the Institute.	Number of vaccinations and re-vaccinations performed with Lymph furnished by the Institute in 1904.	Number of "portions" produced in 1904 by the Institute.	Name of the Director of the Lymph Institute.
1	Königsberg	Provinces of East and West Prussia.	3,560,284	186,965	372,500	Dr. Luchau.
2	Berlin* ..	Brandenburg, including city of Berlin.	3,108,554	182,551	645,200	Dr. Schulz.
3	Stettin* ..	Pomerania	1,634,832	200,648	654,456	Dr. Freyer.
4	Oppeln ..	Posen and Silesia ..	6,556,132	184,852	500,000	Dr. Klose.
5	Halle* ..	Prussian Saxony ..	2,832,616	144,823	196,800	Dr. Risel.
6	Hannover*	Hannover, Schleswig-Holstein, Bremen, Lippe. Schaumburg. and Waldeck	4,423,691	147,845	562,700	Dr. Berger.
7	Cassel* ..	Hesse-Nassau, Westphalia, Hohenzollern.	5,126,720	163,169	614,500	Dr. R. Meder.
8	Cologne* ..	The Rhine Province	5,759,798	276,442	494,000	Dr. E. Meder.
9	Munich* ..	The Kingdom of Bavaria.	6,176,057	?	501,520	Dr. Stumpf.
10	Dresden*..	The Kingdom of Saxony, excluding Leipsig.	3,696,594	123,257	214,388	Dr. Chalybäus.
11	Leipsig ..	The city and suburbs of Leipsig.	505,620	41,153	74,000	Dr. Blass.
12	Stuttgart*	Two-thirds of the Kingdom of Wurtemberg.	1,423,811	72,259	88,186	Dr. Wiedenmann.
13	Cannstatt*	One-third of the Kingdom of Wurtemberg.	745,669	26,605	37,000	Dr. Blezinger.
14	Carlsruhe*	The Grand Duchy of Baden.	1,867,944	94,022	160,000	Dr. Hauser.
15	Darmstadt*	The Grand Duchy of Hesse.	1,119,893	56,579	129,000	Dr. Neidhart.
16	Schwerin ..	The Grand Duchy of Mecklenberg Schwerin.	607,770	36,138	51,000	Dr. Wilhelmi.
17	Weimar* ..	The Grand Duchy of Saxe Weimar, Duchies of Gotha, Meinigen, &c.	1,006,155	?	90,000	Dr. Pfeiffer.
18	Bernburg..	Duchy of Anhalt ..	316,085	?	118,000	Dr. Esleben.
19	Lübeck ..	Lübeck	96,775	?	9,065	Dr. Feldmann.
20	Hamburg*	Hamburg	768,349	35,559	100,000	Dr. Voigt.
21	Strassburg	Elsass	1,154,641	?	80,310	Dr. Eninger.
22	Metz ..	Lothringen	564,829	?	70,000	Dr. Meinal.

* Those marked with an asterisk were visited during the inquiry.

I now proceed to a short description of each of the several vaccine establishments visited by me, and of the methods employed in each instance for producing lymph. Such information as could be obtained respecting the annual expenditure* of the institute, the cost of calves or other animals, &c., is added.

The order in which these establishments are here dealt with follows the order in which they were visited by me, viz. :— (1) Cologne, (2) Darmstadt, (3) Carlsruhe, (4) Stuttgart, (5) Cannstatt, (6) Munich, (7) Dresden, (8) Weimar, (9) Halle, (10) Berlin, (11) Stettin, (12) Hamburg, (13) Hannover, and (14) Cassel.

Cologne.

The Lymph Institute at Cologne, which is situated within the grounds of the public abattoir, was erected in 1889. It supplies vaccine lymph for a population of nearly six millions in the Rhine province. In the report of the late Sir Richard Thorne-Thorne and Dr. Copeman "on the preparation and storage of calf lymph,"† a description is given of this establishment. It is hardly necessary here to repeat that description, but the appended diagram will enable the reader to understand the arrangement of the apartments.

Dr. Edward Meder is the Medical Director. He holds also the appointment of public vaccinator for a portion of Cologne, and he is Medical Officer of Health for that City, which has a population of over 400,000. As his method of collecting lymph is somewhat different from that usually followed in Germany some details of it are requisite. Dr. Meder uses female calves averaging about seven weeks old, their average weight being about 75 kilogrammes. He vaccinates the abdomen of the calf from the umbilicus to the margin of the buttocks, his scarifications not being as usual in single parallel lines, but in double or treble diagonal lines. The calves are kept four days, at a cost in each instance of 6 marks 49 pf. They are fed on ten litres of new milk each per day. The calves are delivered on the Monday in each week, the number that will be required having been previously notified to the contractor who lends each animal at a charge of ten marks. Calves are vaccinated on Tuesday and the lymph is collected on Friday, *i.e.*, at the expiry of 72 hours.

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* The annual expenditure of these vaccine establishments includes salaries of the Medical director, his assistant, the Veterinary surgeon, and the clerk ; also the cost of hire for the calves, their food, and attendance upon them, the warming, lighting and cleaning of the rooms ; also the cost of washing, and the purchase of ice ; the disinfection of the stables, &c., sterilization of instruments and apparatus ; the packing and dispatching of the lymph ; rent of premises ; purchase of new apparatus and furnishings, and other sundry minor expenses.

† Annual Report of the Medical Officer to the Local Government Board for 1896–97, page 55.

On that day each animal is taken from the stable (marked (2) on the diagram) into the vestibule marked (1) where its throat is cut. Thence, after having ceased to bleed, the body is wheeled through the stable into No. 3 room, where, after a preliminary careful washing of the abdomen with special antiseptic soap and hot-water, the lymph is collected.

The vaccinated area of the calf having been scraped by means of a sharp spoon, the collected pulp is placed in a glass and taken to the director's room (No. 4) where it is weighed. Next it is carried to the laboratory (No. 5), where it is triturated by hand in a mortar, and then gradually mixed with glycerine and water, two parts of glycerine to one of water, the proportions being about one part of pulp in six of the mixture. While the pulp is being triturated and emulsified the body of the calf is wheeled back to No. 1 apartment where pathological examination of the internal organs is made, and the carcass is then dressed for sale, and removed to the cold-storage room in the meat market whence it is sold as first-class veal. When a number of calves are vaccinated on the same Tuesday, the pulp collected on the following Friday from each animal is mixed together as soon as a favourable report from the veterinary surgeon has been received. Thus the pulp from as many as eight calves may on occasion be amalgamated, and I understand, that as a matter of experience, it is found that a uniformly active lymph is in this way produced, any less active lymph in the group becoming incorporated with that which is more active. I visited the Vaccine Institute on a Friday at 4 o'clock, and saw four calves slaughtered, and the pulp at once collected, weighed, triturated, and emulsified, and filled into tubes holding each 100 charges or portions; and by 5.30 the resulting lymph was ready for storage. The lymph thus produced is kept usually four weeks in a cold chamber where meat is stored in the abattoir, at a temperature of from 3° to 10° Celsius*, before distribution. No plate cultures of lymph are now made. No chloroform lymph has been produced at this Institute.

Dr. Meder being a public vaccinator is able to test the activity of his lymph at his public stations before sending the bulk of it out to vaccinators in the Province. Though the pulp is collected so early as at the end of 72 hours he does not find that the amount is less than at other establishments, nor is the lymph usually of a less active character than that collected 96 hours after vaccination. Occasionally he judges it permissible to dilute the lymph to 1 in 8 before using it. Dr. Meder says that lymph thus diluted is generally strong enough to ensure success in primary vaccinations, but he prefers to use a stronger lymph for re-vaccination. Re-vaccination he affirms is a better test of the activity of lymph than primary vaccination. Dr. Meder has carried out his method of collecting lymph for some six years, and his predecessor, Dr. Vanselow, did the

* 37°·4 to 50° Fahrenheit.

same for a considerable time also. From the four calves which I saw at my visit there were collected (1) 19½ grammes, (2) 11½ grammes, (3) 23 grammes, and (4) 15 grammes, or an average of 17 grammes per animal. During the year 1904 the average amount of pulp collected per calf was 15·4 grammes; and from 82 calves Dr. Meder obtained 1262·5 grammes of pulp producing 478,400 portions of emulsified lymph, or an average of 5,834 portions per calf.

Dr. Meder's lymph has been found to retain its activity sometimes as long as a year. Besides supplying all the public vaccinators in the Rhine Province with lymph, he sells some to private medical men, in tubes holding four portions, at a charge of one mark per tube. In such small bulk he recommends that it be used at once, or not kept more than three or four days. In larger bulk the lymph retains its activity, he considers, much better. The amount received during 1904 from sale of lymph to private practitioners amounted to £116.

As director of the Animal-Vaccine Establishment Dr. Meder receives a salary of £175 per annum, and his assistant one of £50. The veterinary surgeon has a retaining fee of £25, and the clerk £50. The attendant on the animals and the caretaker are employés at the public abattoir, and receive only a small wage for their part-time services at the Vaccine Institute.

Table II. gives the number of calves vaccinated at the Cologne Institute during the last five years; the average amount of pulp collected from each animal; the total number of portions of lymph produced; the average number of portions obtained from a calf; and the approximate annual expenditure of the establishment:—

Year.	Number of calves vaccinated.	Average quantity of pulp collected per calf.	Total number of portions of lymph emulsion obtained.	Average number of portions from a calf.	Approximate annual cost of the Vaccine Establishment.	Remarks.
		Grammes.			£	
1900 ..	83	11·9	500,000	6,024	507	£91 received for sale of lymph.
1901 ..	80*	11·6	450,000	5,769	511	£92 „ „ „
1902 ..	91	11·1	413,672	4,545	553	£100 „ „ „
1903 ..	85	13·9	420,296	4,944	514	£113 „ „ „
1904 ..	82	15·4	478,400	5,834	593	£116 „ „ „

* 78 used for lymph collection.

The percentage of case success during 1904 in public vaccination with the Cologne lymph was 97·4 for primaries and 95·8 for re-vaccinations. Insertion success, 88·7 per cent. for primaries, and 80·8 for re-vaccinations.

The largest number of calves is vaccinated during the months of March and April, *i.e.*, before the beginning of the public stational attendances in May and June.

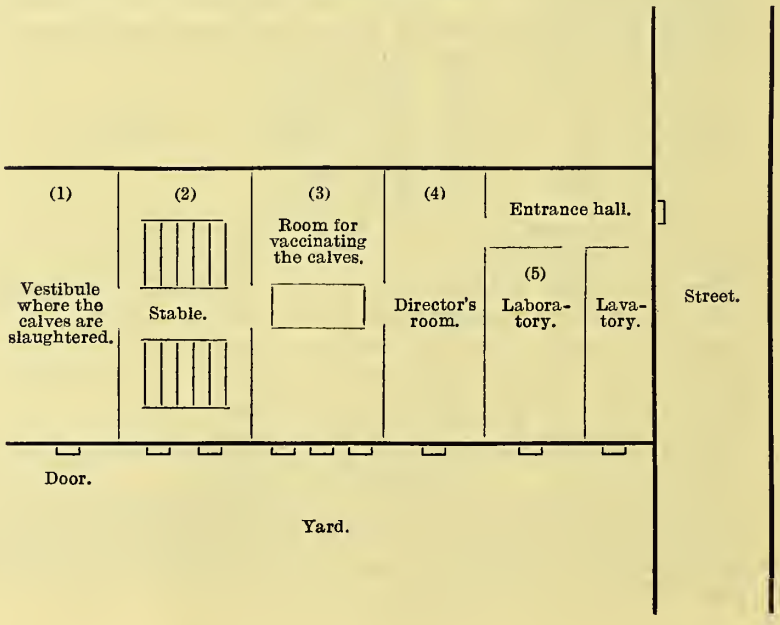
Table III. gives the number of calves vaccinated by Dr. Meder month by month during the last five years :—

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	2	4	16	17	27	—	5	—	6	5	—	1	83
1901 ..	2	2	18	14	24	8	2	—	4	6	—	—	80*
1902 ..	2	5	16	24	17	10	3	3	3	5	1	2	91
1903 ..	—	10	40	16	—	9	—	—	5	3	2	1	86†
1904 ..	—	—	33	16	12	6	3	—	8	2	—	2	82

* Two not used for lymph production.
† 85 only " " " "

To vaccinate a calf Dr. Meder ordinarily uses from $1\frac{1}{2}$ to 2 grammes of emulsified lymph. After the crossed lines are made on the abdomen the lymph is rubbed in carefully with the help of a small square of plate-glass.

Diagram of the Animal Vaccine Establishment at Cologne.



Darmstadt.

The animal vaccine institute at Darmstadt is situated on the outskirts of the town. It was purchased about two years ago at a cost of £1,250, and comprises two stables, a vaccinating room where also the lymph is collected from the animals, a laboratory, an office, and a rabbit-house. There are also rooms for a resident caretaker.

The medical director is Dr. Neidhart (Geheimer-Ober Medizinal Rat) who, in addition to being also public vaccinator for the town, is medical adviser to the Government of the Grand Duchy of Hesse, which had, at the census of 1900, a population of 1,119,893. The animals employed are young bulls from one to two years old; they are supplied on loan, on the requisition of Dr. Neidhart, at a charge of 80 marks (or £4) a head.* On arrival at the institute they are injected at once with tuberculin, and their temperature is carefully taken at intervals during the next three days. If they react they are at once returned to the contractor, who receives no payment for the loan of such animals. Dr. Neidhart prefers young bulls to calves. He says he gets a larger amount of pulp from a single animal at comparatively less cost. The area vaccinated comprises the surface of the abdomen, from the inner margin of the buttocks to the umbilicus, and includes the scrotum; long linear scarifications are made by means of a blunt instrument like a steel pen, the lines being about a centimetre apart. From $1\frac{1}{2}$ to 2 grammes of lymph emulsion are used in the vaccination of each animal, and the lymph is well rubbed in with a spatula. Immediately after vaccination the surface of the abdomen is covered over with a coating of "Tegmin" (*see* page 6). The coating is repeated several times during the period between the vaccination and the collection of the lymph. It is said to protect the vesicles, and also to relieve any irritation felt by the animal in connection with the vaccination. The pulp is generally collected at the end of 96 hours (four days), though on occasion it may be collected at the end of 114 hours. In 1904 the average amount of pulp collected per animal was 29·4 grammes, and from nine young bulls, 129,000 portions of emulsified lymph was obtained, *i.e.*, an average of 14,333 portions per animal.

During the first five months of 1905, Dr. Neidhart had vaccinated only five bulls. From the first of these he obtained 55 grammes of pulp; from the second 65 grammes; from the third 82 grammes; from the fourth 45 grammes, and from the fifth 38 grammes, a total of 285 grammes from five animals, giving an average of 57 grammes per animal.

As soon as it is collected the pulp is triturated and emulsified with a mixture of glycerine and water (2 of glycerine to 1 of water) in the proportion of 1 of pulp in 4 of the mixture. The emulsion is then put into tubes or bottles containing each 100

* The price is likely to be raised shortly to 90 marks, *i.e.*, to £4 10s. English money.

portions and stored in an ice chest in summer, or in the cellar, without ice, in winter. Dr. Neidhart has found his lymph active on occasion when tested at the end of eight months. During the four weeks in which the lymph is stored before distribution, samples are sent at the end of two weeks and again just before the four weeks has expired to the Professor of Bacteriology at Giessen, who makes examination by means of plate cultures as to the presence of extraneous micro-organisms. The cost of this bacterioscopic investigation is borne by the Government of the Grand Duchy. As Dr. Neidhart is public vaccinator for the town of Darmstadt, he is able to test the activity of the lymph on children before distributing it. He also tests it on rabbits. He has used no chloroform lymph as yet. During 1904, in the hands of public vaccinators, primary vaccination with this lymph yielded 99·7 per cent. case success and 92·2 per cent. insertion success; in re-vaccination 99·0 per cent. case success and 88·5 per cent. insertion success.

The staff of the institute comprises :—(1) A Director, Dr. Neidhart, at a salary of £25 per annum; (2) his assistant, who is in private practice, at £15 per annum; (3) a veterinary surgeon at £60 per annum; (4) a clerk; (5) the caretaker and attendant on the animals. The approximate total expenses of this lymph institute for 1904 were £173 18*s*. 9*d*. (This does not however, include any charge for rent, as the building was purchased by the Government of the Grand Duchy two years ago for £1,250, and the above estimate should perhaps be increased by a sum representing interest on that amount.)

Table IV. gives the number of animals vaccinated for lymph production at the Darmstadt Vaccine Institute; the average amount of pulp yielded per animal; the total number of portions of lymph obtained; the average number of portions from an animal; and the approximate total annual expenses of the establishment.

Year.	Number of animals vaccinated.	Average amount of pulp collected per animal.	Total number of portions of emulsified lymph obtained.	Average number of portions per animal.	Approximate annual cost of the Lymph Institute.	Remarks.
		Grammes.			£ *s*. *d*.	
1900 ..	11	34·6	114,180	10,380	169 0 0	£27 7*s*. received from sale of lymph.
1901 ..	11*	34·0	114,800	14,350	162 10 0	£23 14*s*. „ „ „
1902 ..	9	46·0	82,437	9,160	165 0 0	£24 12*s*. „ „ „
1903 ..	12	39·8	85,208	7,100	171 9 6	£23 17*s*. „ „ „
1904 ..	9	29·4	129,000	14,333	173 18 9	£24 12*s*. „ „ „

* The lymph from three of these animals was not used for various reasons.

Hitherto the largest number of animals has been vaccinated in March and April, as will be seen from Table V., which gives the numbers vaccinated month by month in the four years 1901 to 1904 and also in the first half of 1905.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1901	—	—	5	3	—	1	—	1	1	—	—	—	11
1902..	1	1	1	3	1	1	—	1	—	—	—	—	9
1903..	2	—	2	4	—	—	1	—	2	1	—	—	12
1904..	1	—	3	2	1	—	—	—	1	1	—	—	9
1905 (1st half)	—	2	3	—	—	—							5 (half year.)

Carlsruhe.

The animal vaccine establishment at Carlsruhe is situated in the suburbs of the city, within the grounds of the public abattoir close to its main entrance. The building comprises a stable, an operating room, a laboratory and office, and also a large room used as a public vaccination station. Detached from the main building is a stable used for "quarantining" the animals before they are vaccinated, and where is placed a bath in which they are washed before being taken to the operating room.

The Carlsruhe Institute supplies lymph for public vaccination for the Grand Duchy of Baden, which had, at the census of 1900 a population of 1,867,944. The medical director is Ober Medizinal Rat Dr. Hauser, who is medical adviser to the Government of Baden, and public vaccinator for the town of Carlsruhe (population about 103,000). His assistant is Dr. Battlehner, to whom, in the absence of Dr. Hauser, I am much indebted for help and information when I visited Carlsruhe. The veterinary surgeon receives £25 per annum ; he is an official at the public abattoir. The attendant and caretaker resides on the upper floor of the institute.

The animals used at Carlsruhe for lymph production are young bulls, aged from 6 to 18 months. A contractor supplies them on loan at a charge of 40 marks per head. They are not tested with tuberculin, but are kept under observation for some days "in quarantine." The area vaccinated is the abdomen, inner side of the thighs, and scrotum. The abdomen is washed and then

shaved except that two narrow bands of hair are left, crossing each other about the middle of the abdomen, with a view to giving hold to the dressing of "Tegmin," which is always applied after vaccination, and which is renewed if necessary two or three times before the pulp is collected. Tegmin is thought to protect the vesicles from injury, and also to prevent access of dirt to the vaccinated surface. About three grammes of lymph emulsion are used in vaccinating each animal. The pulp is collected on the fifth day, and is at once triturated and mixed with glycerine and water (3 of glycerine and 1 of water); the resulting emulsion finally containing one part of pulp to three of glycerine and water mixture. It is then stored for about four weeks in tubes holding 50 or 100 portions, in an ice chest. No plate cultures are made, and no chloroform lymph has been used at Carlsruhe. Before distribution, the activity of the lymph is tested on children at the public stations. Lymph is distributed gratuitously to all public vaccinators in the Grand Duchy on application, and it is also sold to the military authorities for the re-vaccination of recruits, and to private medical practitioners at the rate of three portions for one mark, six for two marks, and twenty for three marks, being issued to these applicants in capillary tubes. After collection of the pulp the animal is slaughtered and pathologically examined. If it is found healthy the lymph is stored and the flesh of the animal is sold, chiefly it is said as sausage meat.

The most active lymph is collected from the scrotum, and that lymph is, where possible, reserved for vaccination of other animals in the institute.

In the hands of public vaccinators the Carlsruhe lymph, in 1904, gave the following results:—Primary vaccinations, case success, 97·5 per cent.; insertion success, 80·7 per cent. Re-vaccinations, case success, 98·1 per cent.; insertion success, 89·1. It is said that the lymph retains its activity, under favourable conditions, for seven months or more.

In the published reports of the Carlsruhe vaccine establishment, the average amount of pulp collected per animal is not stated, but Dr. Battlehner was good enough to supply me with particulars of the amounts collected from the 12 animals vaccinated in the first five months of 1905, and this works out at an average yield of over 22 grammes of pulp per animal.

In Table VI. are given the number of animals used, in each of the five years 1900 to 1904 inclusive, for lymph production purposes; the total number of portions obtained in each year; the average number of portions obtained per animal; the approximate annual expenditure of the Institute; and the amount realised each year by the sale of lymph.

Year.	Number of animals vaccinated.	Total number of portions of emulsified lymph obtained.	Average number of portions per animal.	Approximate annual expenditure of the Institute.	Amounts realised by the sale of lymph.
				£ s. d.	£ s. d.
1900 ...	35	115,045	3,287	453 3 9	82 10 0
1901 ...	43	111,153	2,585	421 13 4	84 9 0
1902 ...	42	119,567	2,846	432 16 1	88 1 0
1903 ...	23	150,000	6,521	385 12 5	88 11 0
1904 ...	22	160,000	7,272	367 12 3	86 5 9

During 1903 and 1904 the number of animals vaccinated was much fewer than in any of the three previous years. Nevertheless the number of portions of lymph obtained was increased; and, it will be seen that with the reduced number of animals vaccinated there was a marked diminution in the annual expenditure of the Institute.

Table VII. shows the number of animals vaccinated in each month during the five years ended December 31st, 1904, and in the first five months of 1905.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	3	4	8	8	6	3	2	2	6	2	1	—	45*
1901 ..	3	4	8	9	10	—	2	1	5	2	1	—	45†
1902 ..	3	5	9	11	9	2	—	—	7	—	—	—	46‡
1903 ..	2	2	7	4	3	2	—	—	2	—	—	2	24§
1904 ..	1	2	8	6	—	2	—	—	3	—	—	—	22
1905 ..	—	4	6	—	2								12¶

* Only 35 ultimately used for producing lymph.
† 43 used for lymph production.
‡ 42 " " "
§ 23 " " "
¶ To June 1st.

Stuttgart.

The Stuttgart Animal-Vaccine Institute supplies lymph for two-thirds of the population of the kingdom of Wurtemberg; that is, for a population of about 1,423,811.

It is situated on the outskirts of the town. It is of fairly modern construction, and comprises: (1) a stable for the animals; (2) the room in which the animals are vaccinated and the pulp collected; (3) an office for the medical director; (4) and (5) two smaller apartments for laboratory work. On the floor above are rooms occupied by the caretaker, who also attends to the animals.

The Medical Director is Sanitätsrat Dr. Wiedenmann, who is also public vaccinator for the town. As Director he receives a salary of £50 per annum; he has an assistant, a medical practitioner in the town, who receives a salary of £30 per annum. The veterinary surgeon is paid a nominal salary of £13 15*s*. There is a part-time clerk, and an attendant upon the animals. The whole expenses of the Institution in 1904 amounted to £380 10*s*. 5*d*.

The animals used for the production of lymph are young bulls from six to 15 months' old. They are not tested with tuberculin before being vaccinated, but they are "rested" for three days after being delivered by the contractor. The loan of each animal costs 35 marks, and its food is estimated to cost one mark daily. The area vaccinated extends from the inner margin of the buttocks to the navel, including the scrotum, from which, it is said, the most active lymph is obtained. The pulp is collected on the fourth day, and the animal is immediately afterwards slaughtered. It is believed that the flesh of these animals is usually made into sausages. In 1904 Dr. Wiedenmann obtained on an average 15 grammes of pulp per animal, but in 1905, prior to my visit, he had vaccinated 23 bulls, and had obtained an average of 20 grammes per animal. In conversation I learned that some of these larger animals are liable, through struggling on the table, to injure themselves. Also, the larger animals are more prone to exhibit tuberculosis than the smaller ones. Of 74 bulls vaccinated by Dr. Wiedenmann, in 1904, no fewer than 15 had been found tuberculous when they were slaughtered, and the collected pulp, consequently, had to be destroyed.

After collection the pulp is triturated with a mixture of glycerine and water (in equal parts), in the proportion of one of pulp to three of the mixture of glycerine and water. It is then stored in the cellar at Dr. Wiedenmann's residence without the use of an ice chest. It is retained for 14 days before distribution, and one plate culture of the lymph is made by the assistant director during that period. It is said that the lymph kept in the cellar has been found active after six months.

The activity of the lymph produced at Stuttgart in 1904, as shown by the returns sent in by public vaccinators, was as follows:—Primary vaccinations case success 97·7 per cent.; insertion success 81·1 per cent.; re-vaccinations case success 99·5 per cent.; insertion success 87·8 per cent.

In Table VIII. are given the following, viz. :—Number of animals vaccinated in the Stuttgart Vaccine Institute during each of the five years 1900 to 1904 inclusive; the average amount of pulp collected per animal; the total number of portions of emulsified lymph obtained; the average number of portions of lymph per animal; and the approximate annual expenses of the Institute.

Year.	Number of animals vaccinated.	Average amount of pulp yielded per animal.	Total number of portions of lymph emulsion obtained.	Average number of portions per animal.	Approximate annual expenditure of the Institute.	Amount received for sale of lymph.
		Grammes.			£ s. d.	£ s. d.
1900 ...	63*	17·0	76,500	1,700	327 6 0	83 14 0
1901 ...	63†	18·0	81,000	1,557	330 0 0	74 14 0
1902 ...	70‡	15·0	84,411	1,507	365 19 0	79 12 0
1903 ...	67§	18·0	89,118	1,681	358 9 6	78 12 0
1904 ...	74‖	15·0	88,186	1,574	380 19 0	81 9 0

* 18 of these not used for lymph production (10 owing to foot and mouth disease and 8 owing to disease found after the animal was slaughtered), leaving 45 for lymph production purposes.

† 11 found diseased after being slaughtered (7 tuberculous), leaving 52 for lymph production purposes.

‡ 14 found diseased after being slaughtered (all tuberculous), leaving 56 for lymph production purposes.

§ 14 tuberculous, leaving 53 for lymph production purposes.

‖ 15 tuberculous and 3 others diseased, leaving 56 for lymph production purposes.

In Table IX. is given the number of animals vaccinated at the Stuttgart Vaccine Institute month by month in the period January, 1900, to June 4, 1905 (figures for 1901 have not been published).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	7	3	12	10	12	6	—	3	8	2	—	—	63
1901 ..	Not stated in the official reports published.												63
1902 ..	—	12	11	12	12	10	—	2	9	2	—	—	70
1903 ..	—	12	12	9	13	8	—	4	9	—	—	—	67
1904 ..	—	12	14	13	12	10	—	2	11	—	—	—	74
1905 ..	—	12	15	11	12	2*							52*

* To June 4th, the date of my visit.

Cannstatt.

The Cannstatt Animal Vaccine Establishment supplies lymph to a population of about 745,669, *i.e.*, to about one-third of the population of the kingdom of Wurtemberg. The director is Ober-Medizinal Rat Dr. Blezinger, who is also public vaccinator for the town of Cannstatt and the adjoining rural district. As director of the Lymph Institute he receives a yearly salary of £50. The building comprises stable, operating room, and an office. There are also two rooms used for the purpose of a public vaccination station.

The animals used for lymph production are uncastrated young bulls from 10 to 16 months old. They are lent by a contractor at a charge of 35 marks per animal. They are rested two days before they are vaccinated. The feeding and other expenses average 20 marks additional per animal. The pulp is usually collected at the end of 96 hours, but sooner if judged necessary in certain cases, more especially in hot weather. The average yield of pulp in 1904 was 17 grammes per animal, and in 1905 18 grammes. The pulp is at once emulsified with a mixture of glycerine and water in equal parts (the resulting emulsion containing 1 of pulp to 2½ of the mixture of glycerine and water), and decanted into tubes containing each 100 portions, which are then stored in an ice chest at the director's private residence. This lymph, Dr. Blezinger says, he has found active on occasion as long as nine or 10 months. The stored lymph, before distribution, is tested as to its activity on children at the public vaccination stations. There is no testing on rabbits, and plate cultures are not made. Dr. Blezinger believes that the use of larger animals in preference to calves gives better results, and is more economical. In 1904 he used 26 animals, but in 1905, up to the beginning of June, he had only used 18, and did not expect to require any more, as he had plenty of lymph in hand for the rest of the year. The reports of the public vaccinators show that this lymph in 1904 gave for primary vaccinations a percentage of case success of 98·6 and insertion success 89·6 ; while revaccinations gave 99 per cent. case success, and 92·2 insertion success.

Table X. gives the number of animals vaccinated at the Cannstatt Vaccine Establishment during each of the five years, 1900 to 1904 inclusive ; the average amount of pulp yielded per animal ; the total portions of emulsified lymph produced ; the average number of portions per animal ; and the approximate annual expenses of the Institute.

Year.	Number of animals vaccinated.	Average quantity of pulp yielded per animal.	Total number of portions of lymph emulsion produced.	Average number of portions per animal.	Approximate annual expenses of the Institute.	Received for sale of lymph.
		Grammes.			£ s. d	£ s. d.
1900 ...	28*	14·8	62.000	2,480	179 12 3	9 13 0
1901 ...	24†	18·3	41,480	2,765	166 6 5	11 8 0
1902 ...	22	14·3	39,815	1,809	153 2 9	Not stated.
1903 ...	26	13·0	43,200	1,661	158 12 9	11 5 0
1904 ...	26	17·0	37,000	1,423	163 0 0	12 10 0

* 25 used for lymph production. † 15 used for lymph production.

The animals are vaccinated only in the early months of the year, as may be seen by reference to the Table XI., which gives the number of animals used month by month during the last five and a-half years.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	6	8	6	6	2	—	—	—	—	—	—	—	28
1901 ..	4	8	4	6	2	—	—	—	—	—	—	—	24
1902 ..	2	6	6	8	—	—	—	—	—	—	—	—	22
1903 ..	—	8	8	2	6	2	—	—	—	—	—	—	26
1904 ..	—	8	8	6	4	—	—	—	—	—	—	—	26
1905 ..	—	8	6	4	—								18*

* To June 1st.

Munich.

The vaccine lymph establishment for the whole kingdom of Bavaria (population over six millions) is situated at Munich, in the suburb of Au, on the right bank of the River Isar. The buildings are quite new, having been completed in 1904 (*see* plan appended). The site comprises an area of 3,000 square metres. There are four separate series of buildings, viz. :—

(1) A main block, which includes an office and retiring rooms for the medical director and his assistant, with a library and a room for storing documents ; also an office for the lady clerk, who keeps the records, and who packs and dispatches the lymph. In this main building are also a waiting room and an apartment used as a vaccination station. As Medizinal-Rat Dr. Stumpf, the medical

director of the Institute, is also public vaccinator for the whole city of Munich (population over half a million) he attends every evening, except Sundays and public holidays, at the Institute from 5 to 7 o'clock to vaccinate or revaccinate any applicants. I understand that about 2,000 vaccinations have been performed yearly at the central station by this arrangement, including postponed cases and persons to whom the hour or day fixed at other stations has been inconvenient. Above the room just mentioned is accommodation for the lady clerk, who resides with her mother on the premises ; also rooms for the caretaker and his wife, the former acting as porter and as attendant on the calves.

(2) A main stable, in two compartments, containing 26 stalls for large and small animals. From (2) a covered passage leads to

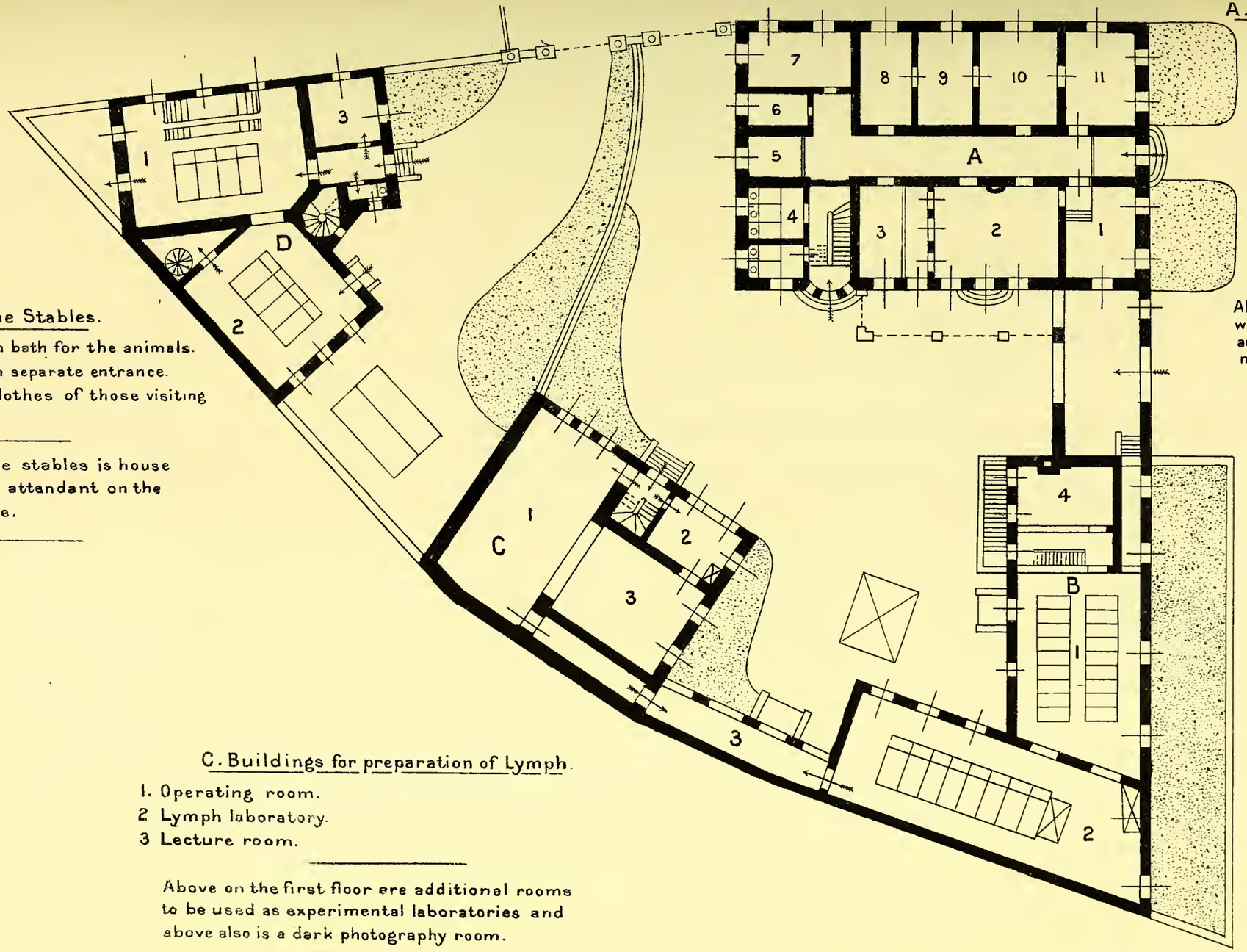
(3) The apartment in which the calves are vaccinated, and to the laboratory, in which the pulp is mixed and emulsified. There is also in this building a class room, opening on one side to the calf vaccinating room, where medical and veterinary students are instructed in the methods for preparing vaccine lymph. Above these rooms are others to be used for research work, photographic room, &c.

(4) Shut off from the rest of the site by a high wall, and entered by a separate gate in a side lane, is a quarantine stable, with stalls, in two compartments, for eight animals, and also a bath for washing the calves. Above this is accommodation for an attendant to wait upon animals suspected to be infected by any epizootic disease. The accompanying plan shows the general arrangement of the buildings on the site. They are built in the picturesque style of an old Franconian farmhouse. The total cost of the buildings, site, and furnishings amounted to £23,250. No expense has been spared either in the building or furnishing of this Institute.

The animals used are in the main calves from five to eight weeks old. In the case of larger animals which are occasionally employed it is usual to inject tuberculin as a preliminary. Dr. Stumpf has not yet come to a decision as to whether calves or larger animals are most suitable ; but he is collecting observations on the subject. The animals are bought at the central cattle market and brought in a wheeled vehicle to the Institute. The price depends on the weight of the animals, which are mostly females. After collection of the lymph the calves are sold back again by weight, there being usually a loss of from 19 to 20 marks on each animal. The average period that a calf remains at the Institute is six days. The lymph is collected on the fifth day. In hot weather the vesicles ripen more rapidly than in cold, and collection of lymph is made in these cases rather sooner than after the lapse of five times 24 hours. The pulp is mixed with glycerine and water (equal parts) in the proportion usually of one of pulp to six of the glycerine and water. This proportion may be varied occasionally, according to circumstances, from one in six to one in nine. The emulsified lymph is placed in glass

GROUND PLAN OF THE ROYAL CENTRAL VACCINE ESTABLISHMENT AT MUNICH COMPLETED IN 1904.

Scale 1:200



A. Administrative Buildings.

1. Hall for perambulators &c.
2. Waiting room.
3. Vaccinating room for children.
4. Lavatories.
5. Porters room.
6. Bath
7. Room for storing records &c.
8. Assistant medical director's room.
9. Library.
10. Medical director's room.
11. Office. for lady clerk.

Above these rooms is another storey in which are rooms occupied by the caretaker and his wife, and by the lady clerk and her mother.

B. Stables.

1. For calves.
2. For larger bovine animals.
3. Covered passage leading from stables to operating room.
4. Heating apparatus.

Above are lofts for hay &c.

C. Buildings for preparation of Lymph.

1. Operating room.
2. Lymph laboratory.
3. Lecture room.

Above on the first floor are additional rooms to be used as experimental laboratories and above also is a dark photography room.

D. Quarantine Stables.

1. 4 Stalled stable with bath for the animals.
2. 4 Stalled stable with separate entrance.
3. Room for changing clothes of those visiting the stables.

Above the quarantine stables is house accommodation for an attendant on the animals in quarantine.

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bottles containing each a hundred portions, and is stored for a month in a cold cellar, the receptacle being surrounded with coils of piping through which cold water circulates. At present it is not the rule to make routine examination of the lymph by plate cultures. It is tested as regards its activity on persons attending at the central station. The lymph is believed to remain active for five or six months.

Table XII. shows the number of calves vaccinated during the last five years; the average amount of pulp collected from each animal; the total portions of emulsified lymph obtained; the average number of portions obtained from an animal; and the approximate yearly expenses of the Institute :—

Year.	Number of calves vaccinated.	Average quantity of pulp obtained per animal.	Total number of portions of emulsion obtained.	Average number of portions from a calf.	Approximate annual cost of the Lymph Institute.	Received for sale of lymph.
		Grammes.			£	£ s. d.
1900	81	7·06	497,000	6,135	760	?
1901	68	8·83	471,900	6,939	907	149 0 0
1902	73	8·34	477,650	6,543	886	211 0 0
1903	70	9·29	471,650	6,737	886	183 15 0
1904	74	8·0	489,000	6,608	1,007	205 9 6

During the first five months of 1905 Dr. Stumpf has vaccinated 88 animals, but 18 of these could not be used owing to illness of one or another kind developing in the animals.

The large majority of the animals are vaccinated in the months of March and April, but in 1905 no less than 32 were vaccinated in May.

Table XIII. shows, month by month, the number of calves vaccinated during the last five years and during the first five months of 1905 :—

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	—	6	31	9	13	7	4	—	3	7	1	—	81
1901 ..	—	5	29	14	6	4	—	1	2	4	2	1	68
1902 ..	—	—	32	11	14	6	—	2	3	3	2	—	73
1903 ..	—	4	36	11	9	2	1	1	1	4	1	—	70
1904 ..	—	1	29	31	—	3	2	1	1	3	3	—	74
1905 ..	—	1	24	31	32								88*

* 5 months only.

The chief demand for calves therefore is limited to the early spring. Each calf receives 10 litres of milk per day, costing about two marks. The calves are conveyed (in a wheeled conveyance) to the public abattoir immediately after their lymph has been collected to be at once slaughtered, and they are pathologically examined by a competent veterinary surgeon, the result being communicated without delay to Dr. Stumpf.

Dr. Stumpf, as director of the Lymph Institute, receives an annual salary of £160, his assistant receiving £60. The veterinary surgeon, who is in the employment of the City Council at the public abattoir, has a nominal salary of about £5 10*s*. The lady clerk receives £50 a year with rooms at the Institute.

Dresden.

The Dresden Vaccine Institute serves practically the whole of the Kingdom of Saxony (with an estimated population of over four millions) except the City of Leipsig, which has a small vaccine establishment of its own, opened chiefly in the summer months, and where students are instructed in animal vaccination.

The Institute is situated in the northern suburbs of Dresden close to the public abattoir. The building, which is two-storeyed, was erected some 20 or more years ago. On the ground-floor are the stables, the operating-room, and a laboratory; while above, on the first-floor, are rooms occupied by the caretaker. In the yard is a so-called quarantine stable, and an outhouse where rabbits are kept. A new Animal-Vaccine Institute with all modern improvements, I understand, will shortly be erected at Dresden. The distribution of the lymph is carried on at the director's residence. The staff comprises the director, Medizinal-Rat Dr. Chalybäus, an assistant, a veterinary surgeon who is an official of the abattoir, a lady clerk, and the caretaker, who is also attendant on the animals.

Dr. Chalybäus is also a public vaccinator for about one-fifth part of the City of Dresden, the population of which is now estimated at 502,000.

The animals used for lymph production are chiefly calves, rather more males than females, aged from six to eight weeks, and weighing from 75 to 100 kilogrammes. But some larger animals (bulls) are also vaccinated, ranging from one-and-a-half to two years old. I understand that at present there is no difficulty in getting animals. Dr. Chalybäus vaccinates annually a number of other animals, *e.g.*, horses, asses, sheep, swine, goats, &c., for experimental purposes. The loan from the contractor entails a

cost of 25 marks for each calf, and for a young bull the charge is 35 marks. The larger animals are on arrival injected with tuberculin, and they are kept under observation for three days. The pulp is collected generally on the 4th, 5th, or 6th day, according to circumstances. The area vaccinated includes the abdomen from the inner edge of the buttocks to the umbilicus, but on the right side the vaccinated area is carried beyond the navel. After vaccination the surface of the abdomen is smeared with Tegmin and covered with a layer of sterilised cotton wool, a dressing which is renewed two or three times as may be required before the time arrives for collecting the pulp. In the majority of cases the collecting of the pulp is effected while the animal is alive, but in a considerable proportion the calf is killed, as at Cologne, before the pulp is collected. Out of 125 animals recently vaccinated by Dr. Chalybäus 78 were alive when the collection of pulp was made, and 44 had been previously killed. The pulp is at once triturated with a mixture of glycerine and water (three of glycerine to one of water) in the proportion of one of pulp to three of glycerine and water mixture, sometimes one to four, and then placed in tubes, mostly of 100 portions each, to be stored for a month. Plate cultures are made about the end of this period before the lymph is distributed. As is invariably the case in Germany a post-mortem examination of the calf is made, and no lymph is stored in instances where signs of disease have been detected in the animal's viscera.

The flesh of animals from the Vaccine Institute is sold in the ordinary way, at the usual prices for first-class meat.

The lymph is sent out to public vaccinators free of charge. Before distribution its activity is tested, sometimes on rabbits, but more usually on children at the public stations. In the earlier part of the year, before his own appointed stations are open, Dr. Chalybäus sends lymph for testing purposes to public vaccinators in various parts of Saxony whose stations are opened sooner in the season than his own.

The Dresden lymph is stated to have been found upon occasion active under favourable conditions up to 12 months. During 1904 this lymph, in the hands of public vaccinators, gave the following results :—Primary vaccinations, case success, 95·2 (insertion success is not given). Re-vaccinations, case success, 95·8. But Dr. Chalybäus' own results at his Dresden public stations were :—primary vaccinations, 99·2 case success; re-vaccinations, 98·3 case success.

The average yield of vaccine pulp per animal at the Dresden institute is somewhat smaller than at other establishments in Germany. In 1902 the average yield was 6·9 grammes per animal; in 1903, 7·44 grammes, and in 1904, 7·0 grammes. The number of animals used for lymph production purposes during

the five years, 1900 to 1904 inclusive, was respectively, 103, 114, 139, 126, and 122. In the published reports of the Dresden Institute the full particulars are not given, so that it is not possible to give here a table, as has been done for the majority of the other German vaccine establishments, showing the average number of portions obtained per animal. But in 1904, the pulp collected from 122 animals produced 293,828 portions of emulsified lymph, giving an average of 2,408 portions per animal.

In the published accounts of the Dresden Vaccine Establishment, the salaries of the medical director and his assistant are not recorded, but excluding these, the annual expenditure of the Institute for the five years, 1900 to 1904 inclusive, was respectively, £465 7*s.* 10*d.*, £501 2*s.* 0*d.*, £560 1*s.* 6*d.*, £513 15*s.* 3*d.*, and £538 11*s.* 0*d.*

Weimar.

The present animal vaccine establishment at Weimar was erected by private enterprise in 1898. It is a one-storeyed building, practically within the grounds of the public abattoir. It comprises under one roof (1) an entrance vestibule with a closet for hanging up clothing, and containing a gas stove for cooking milk, &c., for the calves ; (2) a stable for four calves and two larger animals ; (3) a chamber for storing hay, straw, &c. ; (4) an operating room ; an outbuilding affords accommodation for rabbits, of which a large number are used for producing lymph and for testing purposes. A second stable for observation of animals before vaccination is provided in a separate building connected with the abattoir. The trituration and emulsifying of the lymph, as well as the storing, packing, and despatching of the lymph, is carried out at the residence of the medical director, Geheimer und Hof Medizinal Rat Dr. Pfeiffer.

In addition to the medical director, the staff includes a veterinary surgeon, who is an inspector employed in the public abattoir ; an attendant on the animals, who gives part time only, being employed also in the abattoir ; a barber is employed to shave the abdomen and parts of the calf which are to be vaccinated. The packing and distribution of the lymph and the keeping of the records are carried out by a lady clerk at the director's residence.

The Weimar Institute is of the nature of a private establishment, since it is the property of Dr. Pfeiffer, who contracts with the Governments of Saxe-Weimar, Gotha, Rudolstadt, Gera, Greiz, and Meiningen, to furnish all vaccine lymph required for vaccination in these territories at a charge of 10 pfennigs (about one penny) per portion (*i.e.*, sufficient lymph to vaccinate a person in at least four places).

The animals employed at this establishment for production of lymph are partly young calves and partly oxen; they are hired from a contractor at a charge of 10 marks for a calf and 30 marks for a larger animal. Formerly animals of the latter class were injected with tuberculin when brought to the institute, but this practice has now been discontinued. The larger animals remain six days in the institute and the smaller ones four days; that is, the former are kept under observation for two days before they are vaccinated, but the latter are vaccinated on the day of their arrival. The pulp is collected at the end of four days, in some cases five days, and the animals are immediately afterwards slaughtered and pathologically examined to ascertain if they are free from tubercle. If free from disease the flesh is sold at the usual price for first-class meat. The pulp is triturated and mixed with glycerine and water (equal parts) in the proportion of one part of pulp to three parts of the glycerine and water mixture, but in some cases, especially when the lymph is thick, it is diluted to one in four, five, six, or even seven. As a rule the emulsified lymph is stored for four weeks in a cool cellar at the director's residence, during which time culture plates are sometimes, though not always, made. The lymph is said to retain its activity from six to seven months, but in hot weather it tends to lose its power more rapidly than in cold weather. Dr. Pfeiffer lays some stress upon leaving the emulsified lymph at rest undisturbed during its storage, and at the same temperature, viz., 10 degrees centigrade. He stores it usually in tubes containing 100 portions each. Dr. Pfeiffer also vaccinates rabbits and obtains lymph from them for vaccinating calves. The rabbits are vaccinated on the back, which is first shaved, and then slightly rubbed with sandpaper, after which the lymph is rubbed in. In four days the rabbit is killed and skinned. The skin is then stretched upon a block of wood and scraped with a sharp spoon. The lymph from four rabbits supplies a sufficient amount to vaccinate one calf, being diluted first of all with a mixture of glycerine and water in equal parts.

Dr. Pfeiffer is public vaccinator for the town of Weimar (which has a population of 32,000), and he is able to test the activity of his lymph on children at his public stations. He also tests it on rabbits. At his own vaccination stations the lymph during 1904 gave the following results, viz.:—Primary vaccinations, case success 98·9 per cent.; insertion success 91 per cent.; re-vaccinations, case success 96·9 per cent.; insertion success 85·8 per cent.

Lymph for vaccination of calves is at times collected from the arms of children at the public stations, a small gratuity being given to the mother.

The average amount of pulp which Dr. Pfeiffer obtains from a young calf is about six grammes, and from an ox 40

grammes. On the whole he prefers the larger animals, notwithstanding the drawback that they are more liable to suffer from unrecognised tuberculosis, which, when discovered, postmortem, after collection of the pulp, requires destruction of a large amount of material. In 1900, out of 15 animals vaccinated by him, four of the oxen were found to be tuberculous ; in 1901, out of 17 animals vaccinated three were tuberculous. During the first five months of 1905 Dr. Pfeiffer had vaccinated nine animals, four oxen and five calves, none of which I understand were tuberculous.

About 90,000 portions of lymph are produced annually at this establishment, and the number of bovine animals vaccinated ranges from 10 to 21. During the three years 1902, 1903, and 1904, the average number of portions of lymph obtained per animal was 5,131.

As the Weimar Institute is practically a private establishment I am unable to give the approximate annual expenditure, but, so far as I could judge, the cost of producing lymph at Weimar was about the same as at the other German vaccine institutes of the same size. The whole arrangements are on a simple, though perhaps sufficient, scale.

Halle.

The vaccine institute at Halle is situated within the grounds of the School of Agriculture, in the centre of the town. It is a small building, comprising a stable for calves and a room for vaccinating these animals and for collecting their lymph ; all other work is carried out in two rooms at the private residence of the medical director. Geheimer-Medizinal Rat Dr. Risel, who is also Medical Officer of Health for the town of Halle (present estimated population about 173,832). This establishment furnishes lymph for the whole province of Prussian Saxony, which at the census of 1900 had a population of 2,832,616.

Unfortunately Dr. Risel was absent at the date of my visit, but I received every assistance in my inquiry from Dr. Strube, the assistant director, to whom my best thanks are due.

The animals used at this institute are mostly young male calves, from three to eight weeks old. They are hired from a contractor at 12 marks a head. They are delivered two days before they are vaccinated, and during that period they are " rested." Their average weight is about 60 kilogrammes. The pulp is collected on the fifth day.

After the animal is slaughtered the flesh is sold as first-class veal at the usual price. The area of the animal vaccinated is the abdomen, from the inner margin of the buttocks to the umbilicus. The average amount of pulp collected per calf in 1904 was 16·6 grammes, and from 51 calves a total of 196,800 portions were obtained. The pulp is mixed with glycerine and water (two of glycerine to one of water) in the proportion of one of pulp to three of the mixture, *i.e.*, one in four. The emulsion is put up in phials or tubes containing 100 portions each and stored at Dr. Risel's residence in an ice-chest. During the four weeks period during which the lymph is kept before distribution plate cultures are sometimes, but not regularly, made to ascertain the freedom of the lymph from extraneous micro-organisms.

It is estimated that the cost of procuring a calf, feeding, and attending to it during the period it remains at the lymph establishment, is about 28 marks 68 pfennigs. The total cost of the Vaccine Institute during 1904 was 8,450 marks (£422 10*s.*). The activity of the lymph in 1904, as shown by the returns from public vaccinators, was for primaries, 97·9 per cent. case success, and 85·4 insertion success; while re-vaccinations gave 92·9 case success and 74·2 insertion success. The cost of lymph production at Halle is estimated at about five pfennigs (about a halfpenny) per portion. At Halle it is the practice to vaccinate calves alternately from human lymph. Lymph for calf vaccination is collected in capillary tubes at the public vaccination stations in Halle by Dr. Risel and Dr. Strube, four children yielding sufficient lymph, when diluted with an equal amount of glycerine and water, to vaccinate a calf. Dr. Strube informed me that by this means the lymph produced at this Institute maintained a satisfactory degree of activity. No chloroform lymph is used.

The staff comprises (1) a medical director, who receives 3,750 marks a year (£187 10*s.*); (2) an assistant director, who is a medical practitioner in the town, at £50 per annum; (3) a veterinary surgeon, who receives four marks per calf; (4) a lady clerk, who packs and despatches the lymph as well as assisting in other ways; (5) the attendant on the calves, who acts also as caretaker.

Lymph is sold to private practitioners, and to the military for vaccination of recruits. The sum received in 1904 for sale of lymph amounted to £46 16*s* 9*d*.

Table XIV. gives the number of calves vaccinated for production of lymph during the last five years at the Halle vaccine establishment; the average amount of pulp yielded per animal; the total number of portions of lymph obtained; the average number of portions yielded per calf; and the

approximate annual expenses of the establishment in each year :—

Year.	Number of calves vaccinated.	Average amount of pulp collected per animal.	Total portions of emulsified lymph obtained.	Average number of portions per calf.	Approximate total annual cost of the Vaccine Institute.	Amount received by sale of lymph.
		Grammes.			£ s. d.	£ s. d.
1900 ...	50	17·0	221,000	4,420	386 6 0‡	49 5 0
1901 ...	37*	19·4	169,222	4,700	342 7 0‡	42 19 0
1902 ...	50	16·8	208,000	4,160	432 17 0‡	47 19 0
1903 ...	52†	17·2	233,262	5,301	422 10 0‡	49 3 0
1904 ...	51	16·6	196,800	3,859	422 9 0‡	46 16 9

* 36 used for lymph purposes.
† 44 "
‡ The salary of the lady clerk is not included. She appears to be paid by Dr. Risel and not by the Government. But, judging from what is paid for similar service in other vaccine establishments in Germany, she will receive from £20 to £40 per annum.

The largest number of calves is vaccinated in the months of March and April. During the first half of 1905 forty-five calves were used for production of lymph.

Table XV. shows the number of calves vaccinated at Halle month by month in the last five years :—

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	—	—	12	18	13	—	—	5	2	—	—	—	50
1901 ..	—	—	8	18	5	2	—	—	2	2	—	—	37
1902 ..	—	—	12	14	10	8	—	—	6	—	—	—	50
1903 ..	2	1	31	6	—	6	—	—	2	—	4	—	52
1904 ..	—	—	15	17	6	3	—	4	4	—	2	—	51

Berlin.

The Berlin vaccine establishment supplies lymph for public vaccination to the Province of Brandenburg and the city of Berlin, a total population of over three millions. Lymph is sold also to private medical practitioners and to apothecaries. In

1904 the amount received for the sale of lymph was nearly £220.

The Vaccine Institute at Berlin is situated within the grounds of the central cattle market on the outskirts of the city. It was described by the late Sir Richard Thorne Thorne and Dr. Copeman in their report "On the Preparation and Storage of Glycerinated Calf Lymph," published in the Annual Report of the Medical Officer to the Local Government Board for 1896–97, page 50, as follows :—

> "The station consists of three parts, connected with each other. (1) A large stable containing stalls for the calves ; (2) a workroom fitted with two tilting tables, somewhat similar to those in use in England, on which calves are vaccinated, and the 'lymph' collected ; and (3) the director's room, in which the lymph is triturated, glycerinated, and stored."

This description holds good at the present time, but it may be mentioned that the third room is on the opposite side of the roadway from (1) and (2). Dr. Schulz, the director, informs me that a new institute will shortly be erected not far from the present one, and within the grounds of the central cattle market. Dr. Schulz is public vaccinator for a portion of Berlin, and Medical Officer of Health for the city.

At this institute the calves employed for lymph purposes are all females, from 8 to 12 weeks old. For the loan of each animal a fee of 20 marks is paid to the contractor. Formerly tuberculin injections were made before a calf was used, but this is not now continued. After collection of the pulp the animal is slaughtered, and as soon as the veterinary surgeon has ascertained that the body is free from traces of disease, the trituration and glycerination of the pulp is carried out. It is then placed in tubes each holding 100 portions and stored in an ice chest. The proportion of pulp to the mixture of glycerine and water (equal parts) is one of pulp to five (sometimes six) of the mixture. No plate cultures are now, as a matter of routine, carried out. The activity of the lymph is tested at Dr. Schulz's vaccination station.

In the hands of public vaccinators, in 1904, the results of the use of Berlin lymph were as follows :—Primary vaccinations, 95 per cent. case success, 82·1 insertion success ; re-vaccinations, 94·8 case success, 79 per cent. insertion success.

The average amount of pulp obtained from a calf is a little over 13 grammes. During 1904 Dr. Schulz vaccinated 82 calves, but as one of these was used for experimental purposes, only 81 supplied pulp for lymph emulsion. From these he obtained enough lymph to make 645,200 portions.

In Table XVI. will be found the number of calves used at the Berlin Vaccine Establishment during each of the last five years; the average amount of pulp yielded per calf; the total number of portions produced; the average number of portions per calf; together with the approximate annual expenses of the establishment.

Year.	Number of calves.	Average quantity of pulp collected per calf.	Total number of portions of lymph emulsion obtained.	Average number of portions from a calf.	Approximate annual expenses of the Lymph Establishment.	Remarks.
		Grammes.			£ s. d.	
1900 ..	50	17·2	304,040	6,080	598 12 0*	*£150 received for sale of lymph.
1901 ..	54	13·5	306,526	5,676	599 7 0*	*£167 „ „
1902 ..	69	11·0	296,554	4,297	609 16 0*	*£185 „ „
1903 ..	80	13·2	309,022	3,862	623 11 0*	*£198 „ „
1904 ..	81	13·3	645,200	7,965	645 13 0*	*£219 „ „

It is estimated that each calf costs three marks per day for feeding, viz., five litres of new milk and six eggs daily.

The largest number of calves is vaccinated in the months of April and May. Table XVII. shows the number of calves vaccinated at the Berlin lymph establishment during the five years 1900 to 1904, and in the first five months of 1905:—

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	2	2	6	10	11	9	1	3	4	1	1	1	51*
1901 ..	1	1	4	14	20	4	2	1	3	1	1	3	55†
1902 ..	—	3	3	24	22	6	1	1	5	2	2	1	70‡
1903 ..	1	3	2	25	28	6	1	2	4	3	2	3	80
1904 ..	—	2	4	22	21	15	2	4	4	2	3	2	82§
1905 ..	2	—	3	18	29	7‖	—	—	—	—	—	—	59‖

* 50 used for lymph purposes.
† 54 „ „ „
‡ 69 „ „ „
§ 81 „ „ „
‖ Up to June 15th.

The staff of the institute comprises:—The director, Dr. Schulz, a part time officer at £200 a year; an assistant, who is a practising medical man, at £60 a year; a veterinary surgeon, a part time

officer, at £25 per annum ; a lady clerk at £22 10*s*., and a caretaker and his wife, who attend to the feeding of the calves and the keeping of the establishment in a cleanly condition. The cost of calves, transport, &c., in 1904 amounted to £80, while the cost of feeding and wages of attendant, &c., came to nearly £98. The rent paid for the establishment is £50 per annum.

Stettin.

The Stettin Animal Vaccine Establishment is situated close to the public abattoir, and supplies lymph for the province of Pomerania, which had a population of 1,634,832 at the census of 1900.

At the date of my visit this establishment was undergoing alterations and extensions ; several new rooms were being added as well as an additional stable to provide for isolation of any infected animal. The institution comprises the usual accommodation for stabling calves, an operating room, a laboratory, and an office. The staff includes a medical director, Geheimer-Medizinal Rat Dr. Freyer, who is also a public vaccinator and Medical Officer of Health for Stettin (population now estimated at 225,000). As director he receives a salary of £150. He has an assistant, who is a private medical practitioner in the town, and who receives a yearly salary of £37 10*s*. The veterinary surgeon receives £20 per annum, and a lady clerk, who distributes the lymph, gets £21 a year for her services. There is also an attendant who feeds and waits upon the calves.

The animals used for lymph production are young calves from 8 to 14 weeks old, chiefly females, their average weight being about 73 kilogrammes. The charge for the use of these animals ranges from 8 to 12 marks. There is no difficulty in obtaining calves. Tuberculin is not used to test the animals when they are brought to the institute. The pulp is collected usually at the expiry of 96 hours (four days), and the animal is slaughtered immediately after the collecting of the pulp. As soon as the pulp is collected, it is rubbed up with a mixture of glycerine and water (2 of glycerine and 1 of water) in the proportion of one part of pulp to five of the glycerine and water mixture. It is then "bottled" into small tubes each holding 100 charges and stored in an ice-chest for four weeks, but no plate cultures are made during that period. No chloroform lymph has been made at Stettin as yet. The emulsified lymph is usually distributed from four to eight weeks after its production, but it has occasionally been found active for as long as six months. In the hands of public vaccinators during 1904, the Stettin lymph gave the following results :—Primary

vaccinations 98·3 per cent. case success, and 89·4 insertion success. Re-vaccinations 93·8 per cent. case success, and 79·2 insertion success.

Table XVIII. gives :—(1) The number of calves vaccinated each year from 1900 to 1904 inclusive ; (2) The average amount of pulp collected per animal ; (3) The total number of portions of emulsified lymph produced ; (4) The average number of portions per animal ; (5) The approximate annual expenditure of the institute ; and (6) The amount received for the sale of lymph, as far as this could be ascertained.

Year.	Number of calves vaccinated.	Average amount of pulp collected per animal.	Total number of portions of emulsified lymph produced.	Average number of portions per animal.	Approximate annual expenditure of the Institute.	Amount received for the sale of lymph.
		Grammes.			£ s. d.	£ s. d.
1900 ...	81*	17·6	316,060	4,214	480 2 0	Not stated.
1901 ...	79†	16·4	276,483	3,638	529 13 0	„
1902 ...	66‡	23·0	271,420	4,308	524 0 0	„
1903 ...	75§	17·2	262,691	3,980	536 12 0	„
1904 ...	63‖	17·8	654,456	10,728	507 10 0	37 5 0

* 75 used for production of lymph.
† 76 „ „ „
‡ 63 „ „ „
§ 66 „ „ „
‖ 61 „ „ „

The majority of the calves are vaccinated in the months of March, April and May. Table XIX. gives the number of calves vaccinated month by month during the five years ended December 31st, 1904.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	—	1	13	24	12	10	1	1	9	6	2	2	81
1901 ..	1	1	16	22	16	8	1	3	9	—	—	2	79
1902 ..	2	—	17	16	11	7	2	1	8	1	1	—	66
1903 ..	—	4	17	18	17	5	2	4	1	—	4	3	75
1904 ..	—	4	17	16	13	3	3	2	4	—	1	—	63

The Hamburg Vaccine Institute.

1. Stable for calves.
2. Quarantine stable.
3. Operating room.
4. Store, animals food.

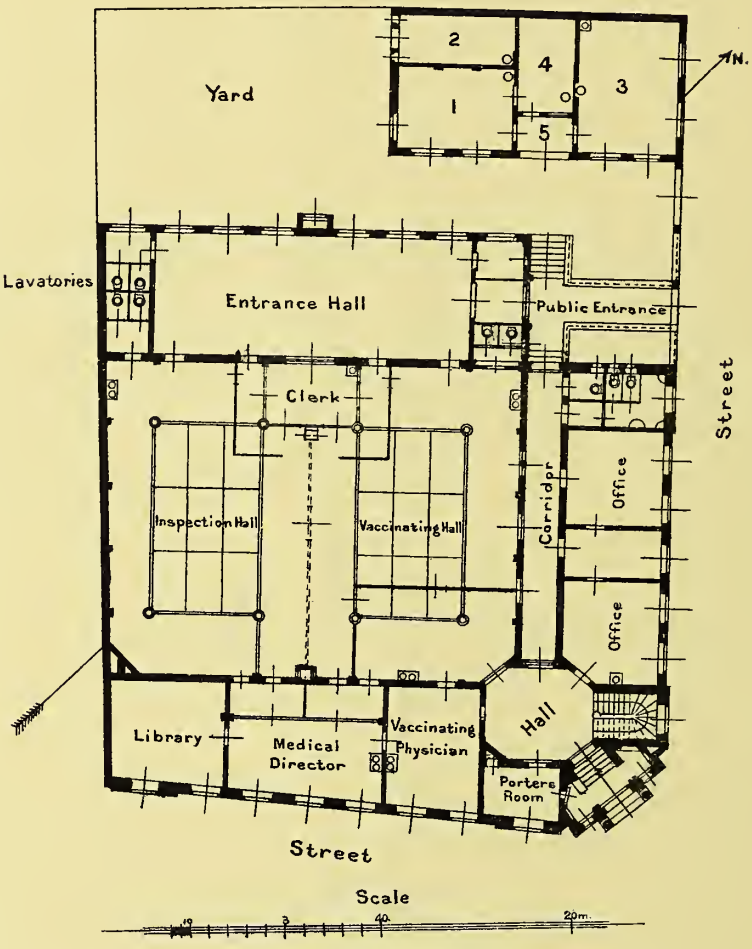

Fig. 1. (Ground floor)

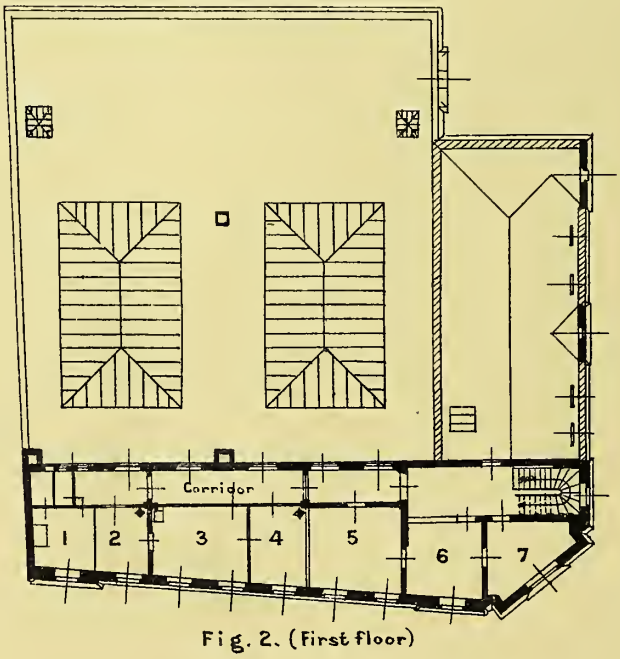

Fig. 2. (First floor)

1. Kitchen. } For caretaker.
2. Room. }
3. Room.
4. Room.
5. Experimental laboratory
6&7 Rooms where lymph is emulsionised and stored.

Hamburg.

The present Vaccine Institute at Hamburg, which serves for a population estimated at 800,000, was erected in 1902, and consists of two buildings, the first devoted to the purpose of a central station for vaccination of infants and for re-vaccination of children in their twelfth year; the second building is devoted to the vaccination of calves. The accompanying plans show the general arrangement of these two sections. The main building comprises, on the ground-floor, a series of rooms for vaccinating children, and a number of apartments used as offices by the staff. On the upper storey are several rooms used as laboratories, and also accommodation for the resident caretaker. The second building comprises two stables for calves, an apartment for vaccinating calves and for collecting lymph, and also a chamber for keeping the food for the calves. In a smaller annex rabbits are kept for experimental purposes. The cost of building the Institute, not including purchase of the site, was £6,350.

The staff comprises Dr. Voigt, the director, who is also public vaccinator for the whole City of Hamburg; he has two medical assistants, who act as deputy public vaccinators; a clerk; a veterinary surgeon, giving part time only; and an attendant who feeds and looks after the calves.

The calves are hired at a charge of 20 marks for each animal, and Dr. Voigt has no difficulty in getting as many calves as he requires. Their age is from 9 to 14 weeks, and their weight varies from 90 to 146 kilogrammes; more male calves than females are used. They are fed chiefly on milk. The lymph is collected on the fifth day; the area vaccinated does not include the belly, but is confined to the perineum and a portion of the right side of the animal from the hip bone to the shoulder. The average quantity of pulp obtained in 1904 per calf was 7·8 grammes. The pulp is emulsified with glycerine and water (2 of glycerine to 1 of water). in the proportion of one of pulp to three of the glycerine and water mixture. But it is sometimes necessary to dilute it further to one in five, in order to get the emulsion to run into capillary tubes. This emulsion is kept for about four weeks in an ice-chest before distribution, and towards the end of the period plate cultures are made to ascertain how far extraneous micro-organisms have disappeared.

The number of calves vaccinated during the last five years is shown in Table XX., which also gives the average quantity of pulp collected per calf; the total number of portions of lymph obtained during the year; and the average number of portions obtained per animal.

Year.	Number of calves vaccinated.	Average quantity of pulp per calf.	Total number of portions of lymph emulsion obtained.	Average number of portions from a calf.	Remarks.
		Grammes.			
1900 ...	42*	6·9	84,000	2,333	*36 used for lymph purposes.
1901 ...	46†	5·4	76,000	1,949	†39 „ „ „
1902 ...	49	6·3	92,221	1,882	
1903 ...	41‡	6·75	110,000	2,750	‡40 „ „ „
1904 ...	45§	7·8	100,000	2,857	§35 „ „ „

In addition to the calves a large number of rabbits are vaccinated, in order to test the activity of the lymph and for other purposes. The activity of the lymph is also carefully noted on the children vaccinated at the Institute. Dr. Voigt has also made experimental vaccinations of sheep, pigs, cats, &c.

In the hands of Dr. Voigt and his assistants, in 1904, the results of the use of this lymph were as follows :—Primary case success 99·5 per cent.; re-vaccinations case success 85·6 per cent. The insertion success is not given.

During the last five years 223 calves have been vaccinated in the Institute, and of these 142 were males and 81 females.

Table XXI. shows the number of calves vaccinated month by month during the last five years.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	4	—	9	3	8	3	5	5	1	2	2	—	42
1901 ..	—	1	10	7	6	8	1	6	5	1	1	—	46
1902 ..	1	1	9	6	2	9	8	6	3	1	3	—	49
1903 ..	2	4	6	4	5	3	1	5	3	6	1	1	41
1904 ..	2	1	7	4	5	6	6	8	1	1	1	3	45

No lymph is sold at Hamburg. It is supplied free of charge to all private medical men in the city.

In calculating the cost of the Animal-Vaccine Establishment at Hamburg it is not easy to separate the expenses from those of public vaccination.

Dr. Voigt receives a yearly salary of £350, and his two assistants £100 each. The clerk receives £78 15*s.* per annum. The veterinary surgeon is in the employment of the Government, and payment for his duties at the Vaccine Establishment are included in his annual salary and are not separately charged. The attendant on the calves gets £61 5*s.* per annum, with rooms. The total expenses of the Lymph Institute in 1904 amounted to 25,738 marks (£1,286 18*s.*), but a portion of this must be allotted to the public vaccinator and his assistants, and to the up-keep of the central vaccination station.

Hannover.

The Animal Lymph Establishment at Hannover, which serves the province of Hannover and a number of smaller States with a total population of about 4½ millions, is situated on the outskirts of the town, within the grounds of the public abattoir. It comprises two stables, with separate entrances ; in one of these stables calves are rested and observed for two days, after which interval they are vaccinated and put in the second stable, where they remain four days. The pulp is then collected at the expiry of 96 hours from the vaccination, and the animals are at once slaughtered. It is considered here that the most active lymph is got from the inside of the calf's thighs. The other apartments in the institution are the operating room, a laboratory, where the pulp is emulsified, and an office. The lymph is stored in an ice-chest. The emulsion contains one part of pulp usually to five of glycerine and water (two of glycerine to one of water). This lymph is kept generally four weeks before distribution, and plate cultures are made each week. Before being sent out the lymph is tested on children at the public station.

Dr. Berger, the medical director of the institute, is a public vaccinator for the town of Hannover and is also Medical Officer of Health for that city, which has a population estimated at over 250,000. As director of the Animal Vaccine Establishment he receives a yearly salary of £150 ; he has an assistant, a medical practitioner in the town, who receives £50 a year. The veterinary surgeon receives £25 a year. A lady clerk distributes the lymph and keeps the records ; she receives the sum of £37 10*s.* per annum. An attendant, who is employed in another capacity in the public abattoir, feeds and waits upon the animals.

The animals vaccinated at Hannover are female calves about 12 weeks old, loaned to the institute by a contractor at a charge

of 12 marks per animal. No difficulty is experienced in obtaining calves, but the price tends to get higher. The lymph has been found to retain its activity for at least four months, and it is sometimes found active after eight months. The lymph from the Hannover Institute gave the following results in 1904 in the hands of the public vaccinators, viz. :—Primary vaccinations, case success 96·2 per cent. ; insertion success 80 per cent.; re-vaccinations, case success 90·4 per cent. : insertion success 70·1 per cent.

Table XXII gives the number of calves vaccinated at the Hannover Vaccine Establishment during the five years, 1900 to 1904 inclusive ; the average quantity of pulp yielded per animal ; the total number of portions of lymph produced ; the average number of portions per animal ; and the approximate annual expenditure of the vaccine institute.

Year.	Number of calves vaccinated.	Average quantity of pulp yielded per animal.	Total number of portions of lymph emulsion produced.	Average number of portions per animal.	Approximate annual expenditure of the Institute.	Received for sale of lymph.
		Grammes.			£ s. d.	£ s. d.
1900 ...	57	17·1	406,750	7,136	399 18 0	83 11 0
1901 ...	55	17·0	394,300	7,169	426 17 0	58 14 6
1902 ...	59*	18·4	423,425	7,428	436 10 0	58 2 0
1903 ...	60	18·3	476,225	7,937	436 0 0	70 13 3
1904 ...	90†	15·7	562,700	6,698	449 0 0	75 6 2

* 57 used for lymph production.
† 84 " "

The number of calves employed for lymph purposes at the Hannover Vaccine Establishment month by month for the five years, 1900 to 1904 inclusive, is given in Table XXIII.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	6	4	16	12	12	4	—	3	—	—	—	—	57
1901 ..	6	10	6	6	7	9	2	—	4	3	2	—	55
1902 ..	—	16	6	4	4	15	—	—	10	2	—	2	59
1903 ..	—	8	20	—	12	5	—	—	9	3	—	3	60
1904 ..	—	6	30	—	14	12	—	—	8	1	11	8	90

Cassel.

The lymph institute at Cassel is situated within the grounds of the public abattoir. Its arrangements are very similar to those described already in the other vaccine establishments, and comprise a stable, an operating room, a laboratory, and an office. A new institute is to be built at Cassel, close to the old one, at an estimated cost of 40,000 marks (£2,000), but this amount does not include the expenses connected with fittings and furnishing. The present establishment supplies lymph for the Provinces of Hesse-Nassau, Westphalia, and Hohenzollern, with a population (census of 1900) of 5,126,720. The medical director is Dr. Richard Meder, who receives a yearly salary of £150. He is public vaccinator and Medical Officer of Health for the town of Cassel (estimated population about 120,000), and he also engages in private practice. He has an assistant, a medical practitioner in the town, who has a salary of £50 per annum. The veterinary surgeon receives £25 a year for his services. The distribution of the lymph is undertaken by a lady clerk, who also keeps the records, at an annual salary of £30. There is also a part-time attendant, who feeds and waits upon the calves, and for these services he is paid £21 yearly.

The animals used for the production of lymph are young calves, aged from four to six weeks, mostly males. Their average weight is from 50 to 60 kilogrammes. The animals are supplied by a contractor on loan at a charge of seven marks, but for older calves the charge is 10 marks. The calves each receive 10 litres of boiled milk daily, and they usually gain in weight. During 1904 the average gain per animal was 2·7 kilograms. The animals are rested for two days before being vaccinated. No injection of tuberculin is practised. The pulp is collected at the expiry of 88 hours, and the animal is at once slaughtered. Dr. Meder informed me that when the new institute is built he proposes to have the calves slaughtered just before the lymph is collected, as is done at Cologne, where his brother, Dr. Edward Meder, is director (*see* page 11). As soon as the pulp is collected it is triturated with glycerine and water (4 of glycerine and 1 of water), the resulting emulsion finally containing one of pulp to five of the glycerine and water mixture. The emulsified lymph is then stored in an ice chest, where it remains usually four weeks before it is distributed; but it occasionally happens that the lymph is sent out earlier than this. No plate cultures are made during the time the lymph is stored. No chloroform-lymph has been used. Cassel lymph is said to retain its activity as a rule for six months or more. Before it is distributed the lymph is tested by Dr. Meder, as to its activity, on rabbits, or on children at the public stations. In the hands of the public vaccinators this lymph has yielded the following results during 1904 :—Primary vaccination, 89·3 per cent. case success, and 64·8 per cent. insertion success; re-vaccinations, 82·8 per cent. case success, and 56·8 insertion success. I was informed that the results in 1904 were,

for some reason or other, below those usually obtained from the use of the Cassel lymph. Dr. Meder, after he has been informed by the veterinary surgeon that animals have been found free from disease, mixes the lymph of those calves from which the pulp has been collected on the same day, so that the more active lymph in the series may compensate for the less active.

Table XXIV. gives the number of calves vaccinated at Cassel vaccine establishment during the five years 1900 to 1904 inclusive; the average quantity of pulp yielded per animal; the total number of portions of emulsified lymph produced; the average number of portions per animal; the approximate annual expenditure of the institute; and the amount realised by sale of lymph so far as this could be ascertained.

Year.	Number of calves vaccinated.	Average amount of pulp yielded per animal.	Total number of portions of emulsified lymph produced.	Average number of portions per calf.	Approximate annual expenditure of the Institute.	Amount realised by sale of lymph to private practitioners and others.
		Grammes.			£ s. d.	£ s. d.
1900 ...	63	14·3	425,250	6,750	Not stated.	Not stated.
1901 ...	46	17·2	379,000	8,239	„	„
1902 ...	52	17·4	419,500	8,067	„	„
1903 ...	55	16·2	480,000	8,727	377 16 7	„
1904 ...	87*	15·7	614,500	7,229	425 0 0	73 9 10

* 85 used for lymph production.

The busiest months, when most calves are vaccinated, are March and April. In Table XXV. is given the number of calves vaccinated in each month at the Cassel Institute during the five years 1900 to 1904 inclusive.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1900 ..	—	—	16	13	16	10	—	—	1	7	—	—	63
1901 ..	—	—	12	16	8	2	1	—	3	4	—	—	46
1902 ..	—	—	14	16	8	1	1	2	6	4	—	—	52
1903 ..	1	2	18	10	6	8	—	2	3	4	1	—	55
1904 ..													87

In Appendix A. will be found tabulated some information regarding the two Austrian Vaccine Institutes at Vienna and at Neuhaus (Bohemia); and also similar information regarding the British Army Vaccine Institute at Aldershot in Appendix B.

R. BRUCE LOW.

August, 1905.

APPENDIX A.

Vienna Lymph Institute.

Some statistics* as to number of animals vaccinated, average amount of pulp per animal, the total portions of lymph obtained, and the average number of portions per animal :—

Year.	No. of animals vaccinated.	Average amount of pulp per animal.	Total portions of emulsified lymph obtained.	Average number of portions per animal.	Results.
1894 ...	125	26·4	611,955	4,895	
1895 ...	99	23·5	640,285	6,467	
1896 ...	84	37·6	676,935	8,059	
1897 ...	92	25·0	623.045	6,772	
1898 ...	131	34·8	822,710	6,280	
1899 ...	108	44·6	804,925	7,453	Primary, 90·2 per cent.; revac., 90·0 case success.
1900 ...	69	50·2	636,430	9,223	Primary, 91·0 per cent. revac., 88·8 case success.

Cost of the loan of each animal, 40 kronen† ; food, 12 kronen 24 heller ;‡ making a total of 52 kronen 24 heller per animal. Total for loan, feeding and attendance on animals in 1900 = 3,758 kronen ; in 1899 = 5,438 kronen.

The emulsion contains 1 part pulp to 3 of glycerine and water (4 of glycerine and 1 of water).

In 1899–1900 nearly all the animals used were bulls aged from 1 to 2 years.

Lymph collected from 120 to 144 hours after the vaccination. Animals slaughtered immediately after lymph taken.

Lymph kept 3 or 4 weeks ; and plate cultures made.

* From "Das Oesterreichische Sanitätswesen," 1901.
† A krone equals about 10*d.* of English money.
‡ 100 heller are equal to one krone.

BOHEMIA.

Some figures from the Report on the Vaccine Lymph Institute at Neubaus, Bohemia, from 1897 to 1903, by Dr. Johann Rybak (Oberbezirksarzt) :—

YEAR.	Number of animals vaccinated.	Average amount of pulp from an animal.	Number of portions of vaccine emulsion obtained.	Average number of portions obtained per animal.	——
		Grammes.			
1897 ...	27	45·55	221,135	8,190	
1898 ...	24	51·04	267,235	11,134	
1899 ...	42	40·75	305,070	7,263	
1900 ...	49	36·55	372,345	7,598	
1901 ...	51	32·53	368,998	7,235	
1902 ...	50	40·30	384,761	7,695	
1903 ...	60	38·38	385,245	6,420	

The lymph is emulsified in the following proportions, viz. :—1 part pulp to 3 parts of glycerine and water.

In 1903 each animal cost 50 kronen.

Average age of animals (mostly females) 15 to 18 months; average weight, 240 kg.

Average duration of stay of animal in institute = 6 days.

This establishment was opened in 1897.

APPENDIX B.

British Army Vaccine Institute, Aldershot.

This Vaccine Institute is carried on under the direction of the Army Veterinary Department, which also distributes the lymph. Calves from three to four months old are bought, and after vaccination and collection of pulp are sold again, at a loss.

The average amount of pulp collected from a calf is 26·07 grammes. The following is a summary of the facts relating to the Aldershot Vaccine Institute for the five years ending March 31st, 1905 :—

Year ended March 31st.	Number of Calves vaccinated.	Number employed for lymph production.	Total number of portions produced.	Average number of portions per animal.	Cost of Calves per head, in each year.
					£ s. d.
1901	17	17	113,662	6,686	2 1 2½
1902	21	21	189,392	9,018	2 8 4½
1903	42	32	132,480	4,140	2 5 5½
1904	38	37	121,921	3,295	2 16 4½
1905	59	56	115,479	2,062	2 3 2

The staff employed consists of two veterinary officers (also engaged on other work at Aldershot) and three men. The rent paid for the Institute, which is a small building, is £15 per annum. During the last three years a lessened surface of the calves' abdomen has been vaccinated, hence a reduction in the amount of pulp collected.

Until last year the lymph was sent out in tubes or "tablets" containing enough for five or ten vaccinations, but now it is sent out in capillary tubes each containing sufficient for a single vaccination. It may be added that plate cultures of the lymph are made during each of the four weeks after it is collected and before it is sent out. The results of these cultures are so uniformly the same that it is thought that they are now hardly necessary.